Review Of Diverse Techniques Used For Effective Fractal Image Compression

Shephali D. Wakalkar[1], Dr. P. R. Rothe[2], Prof. Mr. C. N. Bhoyar[3]

[1] M.Tech Student, Department of Electronics Engineering, P.C.E, Nagpur, Maharashtra, India
[2] Assistant Professor, Department of Electronics Engineering, P.C.E, Nagpur, Maharashtra, India
[3] Assistant Professor, Department of Electronics Engineering, P.C.E, Nagpur, Maharashtra, India

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Abstract - *The image compression in an image processing plays an important role since the beginning of Internet era and telecommunication. It is necessary for efficient storage and transmission of image. Fractal image compression (FIC) is one of the most suitable image compression approaches for its high compression ratio and quality of retrieved images. Many algorithms are available to compress an image file like Quad tree Partitioning Huffman Coding (QPHC), Discrete Cosine Transform based FIC (DCTFIC), Discrete Wavelet Transform based FIC (DWTFIC), Grover's quantum search algorithm based FIC (QAFIC)and Tiny Block Size Processing algorithm(TiBS). This paper presents different approach of designing a fractal image compression in order to enhance the compression ratio with low losses in the image.*

Key Words: Image Processing, Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Fractal Image Compression (FIC), Grover's Quantum Search Algorithm (QSA), Tiny Block-Size Processing Algorithm (TiBS).

1. INTRODUCTION

Images are very useful documents nowadays for a number of applications. They need to be compressed before storing and transmitting, due to limited bandwidth and storage capacity. Image compression plays an important role in multimedia and digital communication fields. The purpose of image compression is to reduce irrelevance and redundancy of the image data in an efficient form. This not only reduces the storage cost but also increases the speed of transmission.

Image compression is divided into two categories which are Lossy as well as Lossless [1]. In lossless compression, the reconstructed image after compression is numerically same as the original image. Thus, it gives good quality of compressed images, but yields only less compression. In lossy compression [2], the reconstructed image contains some degradation comparative to the original due to loss of data with higher compression ratio. For lossless image compression, various approaches available are Variable-Length encoding, Adaptive dictionary algorithms such as Bit-plane coding , LZW coding, lossless predictive coding, etc. For lossy compression, various approaches are lossy predictive coding and transform coding such as Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) [3].

Fractal image compression (FIC) was firstly proposed by Arnaud E. Jacquin [4]. It is one of the lossy compression technique with high Compression ratio and fast decompression times. The decoding phase is independent of the reconstructed image and the reconstructed image is of good quality [5]. FIC is based on fractal geometry that means split geometric shapes that can be break into parts, each of which is a decreased-size copy of the total, a property called self-similarity [6]. FIC is good for natural images and textures because they exhibits enormous amount of self-similarities. So there is huge work load of searching self-similarities, which lead to FIC rapid development.

In recent years, many FIC algorithms have been proposed, such as discrete cosine transform based FIC (DCT-FIC) [7], Discrete wavelet transform based FIC (DWT-FIC) [8], Baseline FIC etc. But reducing intrinsic computational complexity of FIC is still a problem. Fortunately, L. Grover [9]–[11] invented Grover's quantum search algorithm (QSA), based on quantum computing. The idea of quantum computing is brought into FIC, to utilize quantum particles as a computational resource in order to reduce search complexity in FIC. C. Zalka [12] proved that Grover's QSA is precisely best in search problems. This Grover's quantum search algorithm based FIC (QAFIC) reduces the time complexity of FIC drastically and maintain quality of retrieved images without sacrificing the compression ratio. For the above reasons and motivations, in this research, we try to use this QAFIC algorithm for further improvement.

2. LITERATURE REVIEW

The research papers on the design of fractal image compression are published in different journals and presented in many conferences.

Utpal Nandi and Jyotsna Kumar Mandal et. al.[13] designed an image compression based on the new fast classification scheme with quadtree partitioning method. In this method, the quadtree partitioning scheme where a range is broken up into four equal sized sub-ranges and the classification scheme divides square block of image (range/domain) into 16 sub-block. For each block, a 64 bit ID is generated. The ID has row part and column part each of 32 bits. The row part has four 8 bit sub-ids- ID1, ID2, ID3 and ID4. To generate ID for each row, each sub-block are assigned a two bit code out of four possible codes 00, 01,10 and 11 that are termed as row code (RC). Similarly, to generate ID for each column, each sub-block are assigned a two bit code out of four possible codes 00, 01, 10 and 11 that are termed as column code (CC). This classification scheme reduces the compression time as compared to the other image compression techniques, also maintain the same compression ratio and peak signal to noise ratio (PSNR).

Chong Fu and Zhi-liang Zhu [14] designed a new block classification method based on the edge characteristic of an image block. There are total three steps for the functioning of Discrete Cosine Transform based fractal image compression (DCT-FIC). First one is image partition in which image is partitioned into non overlapping a set of pixels range blocks and overlapping set of pixels domain blocks. Second one is image block classification in which the range and domain blocks are divided into three classes based on their DCT lower frequency coefficients and third one is best match exploiting in which only the domain blocks match with the range block are calculated. The classification is based on the lower frequency horizontal and vertical DCT coefficients of an image block. This method considerably improves the fractal encoding speed and also satisfied the fidelity of the reconstructed image.

Padmavati. S and Dr. Vaibhar Mesharam [15] designed an image compression on hybrid methodology. In this methodology, the lossy and lossless compression methods are combined. Firstly, the given image is compressed using DCT and compression on similar blocks of the image is avoided by fractal quadtree image compression. Finally the image is encoded effectively by using Huffman encoding which improves the quality of the compressed image. The combination of DCT and fractal quadtree decomposition was successful in terms of reducing the encoding time and maintaining the quality of the image. This technique is also applied to many real time applications such as medical images, satellite images, etc. There is also improvement in compression ratio as compared to the normal fractal compression using quadtree decomposition of image.

Mehdi Masoudi Chelehgahi and Mohsen Derakhshan Nia [16] designed an image compression based on high speed intelligent classification algorithm using DCT coefficients. This method is particularly designed to reduce the encoding time. In this method, it reshape the given image into 1D array and calculate the DCT and standard deviation of each row.

Ahmad A. Nashat and N. M. Hussain Hassan [17] designed an image compression based upon the Wavelet Transform and the Statistical Threshold. This method is based on the Haar Wavelet transform. The Discrete Wavelet Transform (DWT) of the image is generated by obtaining wavelet decomposition coefficients for the desired levels. The histogram for the selected level is calculated and a threshold for the decomposed image coefficient is selected which is based upon the statistics of the histogram. Then wavelets combines with fractal image in order to get the best results for image compression and decompression. This fractal image compression with wavelet transform can effectively solve the noise problem.

Cristian Duran-Faundez, Vincent Lecuire, Francis Lepage were proposed the Tiny block-size coding [18], for energy-efficient image compression and communication.Tiny Block-Size algorithm (TiBS) is a lossy compression algorithm. It wiil enhance the compression ratio and also reduces the effects which might occur due to the lossy nature of normal Fractal Image Compression (FIC). Since DCT or DWT is computationally intensive, the Encoder in TiBs does not use DCT or DWT. This algorithm operates on blocks of 2x2 pixels. Each block is encoded independently, based on three stages: uniform scalar quantization, self-adaptive pixel removal, and variable-length coding.

3. CONCLUSIONS

The study of papers shows different approaches of designing the fractal image compression. Fractal Image Compression has been implemented using Quadtree Partitioning with Huffman Coding (QPHC) algorithm, DCT based Fractal Image Compression Algorithm (DCT-FIC), DWT based Fractal Image Compression Algorithm (DWT-FIC), Tiny Block Size Processing based Image Compression Algorithm (TiBS) and Grover's Quantum Search Algorithm based Fractal Image Compression (QAFIC). Especially, QAFIC performs better for the images that consist of detailed view and structural similarities. It reduces the intrinsic computational complexity and maintain the quality of retrieved images without sacrificing compression ratio. A new approach can be proposed for image compression where QAFIC is combined with TiBS which shall enhance the compression ratio with low losses in the image.

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